

AMENDMENT TO THE CLAIMS

Claims 1-30 (Cancelled)

31.(New) An antenna apparatus comprising:

a dielectric substrate including a grounding conductor;

a minute loop antenna provided to be electromagnetically close to said dielectric substrate, said minute loop antenna having a predetermined number N of turns and having a predetermined minute length, said minute loop antenna operating as a magnetic ideal dipole so that a magnetic current flows so as to cross said minute loop antenna when a predetermined metal plate is located closely to the antenna apparatus; and

at least one antenna element connected to said minute loop antenna, said at least one antenna element operating as a current antenna so that said at least one antenna element is top-loaded by said minute loop antenna and currents flow in both of said minute loop antenna and said at least one antenna element when said metal plate is located apart from the antenna apparatus;

wherein said antenna apparatus further comprises at least one first capacitor connected to at least one of said minute loop antenna and said antenna element, said at least one capacitor series-resonates with inductances of said minute loop antenna and said antenna element,

wherein one end of said antenna apparatus is connected to a feeding

point, and another end of said antenna apparatus is connected to the grounding conductor of said dielectric substrate, and

wherein said antenna apparatus operates as a magnetic ideal dipole by said minute loop antenna when said metal plate is located closely to the antenna apparatus, while said antenna apparatus operates as a current antenna by said at least one antenna element when said metal plate is located apart from the antenna apparatus.

32.(New) The antenna apparatus as claimed in claim 31,

wherein said at least one antenna element is provided to be substantially parallel to a surface of said dielectric substrate.

33.(New) The antenna apparatus as claimed in claim 31, comprising two antenna elements.

34.(New) The antenna apparatus as claimed in claim 33,

wherein said two antenna elements are substantially linear and provided to be parallel to each other.

35.(New) The antenna apparatus as claimed in claim 31,

wherein said first capacitor is connected so as to be inserted into a

substantially central point of said antenna element.

36.(New) The antenna apparatus as claimed in claim 31,

wherein said first capacitor is formed by connecting a plurality of capacitor elements in series.

37.(New) The antenna apparatus as claimed in claim 31,

wherein said first capacitor is formed by connecting a plurality of pairs of circuits in parallel, each pair of circuits being formed by connecting a plurality of capacitor elements in series.

38.(New) The antenna apparatus as claimed in claim 31, further comprising an impedance matching circuit connected to the feeding point, said impedance matching circuit matching an input impedance of said antenna apparatus with a characteristic impedance of a feeding cable connected to the feeding point.

39.(New) The antenna apparatus as claimed in claim 31,

wherein said minute loop antenna is provided so that a loop axis direction of the minute loop antenna is substantially perpendicular to the surface of said dielectric substrate.

40.(New) The antenna apparatus as claimed in claim 31,

wherein said minute loop antenna is provided so that a loop axis direction of the minute loop antenna is substantially parallel to the surface of said dielectric substrate.

41.(New) The antenna apparatus as claimed in claim 31,

wherein said minute loop antenna is provided so that a loop axis direction of the minute loop antenna is inclined at a predetermined inclination angle with respect to the surface of said dielectric substrate.

42.(New) The antenna apparatus as claimed in claim 31,

wherein the number N of turns of said minute loop antenna is substantially set to $N = (n - 1) + 0.5$, where n is a natural number.

43.(New) The antenna apparatus as claimed in claim 42,

wherein the number N of turns of said minute loop antenna is substantially set to $N = 1.5$.

44.(New) The antenna apparatus as claimed in claim 31, further comprising:

at least one floating conductor provided to be electromagnetically close to said minute loop antenna and said antenna element; and

a first switch device for selectively switching said floating conductor so as to or not to be connected to said grounding conductor, to change one of a directivity characteristic and a plane of polarization of said antenna apparatus.

45.(New) The antenna apparatus as claimed in claim 44, further comprising two floating conductors provided to be substantially perpendicular to each other,

wherein said first switch device selectively switches said respective two floating conductors so as to or not to be connected to said grounding conductor, to change at least one of the directivity characteristic and the plane of polarization of said antenna apparatus.

46.(New) The antenna apparatus as claimed in claim 31, further comprising:

a first reactance element connected to at least one of said minute loop antenna and said antenna element; and

a second switch device for selectively switching said first reactance element so as to or not to be shorted, to change a resonance frequency of said antenna apparatus.

47.(New) The antenna apparatus as claimed in claim 46,

wherein said second switch device includes a high-frequency

semiconductor device having a parasitic capacitance when said second switch device is turned off, and

wherein the antenna apparatus further includes a first inductor for substantially canceling the parasitic capacitance.

48.(New) The antenna apparatus as claimed in claim 31, further comprising:

a second reactance element having one end connected to at least one of said minute loop antenna and said antenna element; and

a third switch device for selectively switching another end of said second reactance element so as to be grounded or not to be grounded, to change the resonance frequency of said antenna apparatus.

49.(New) The antenna apparatus as claimed in claim 48, further comprising a third reactance element connected to at least one of said minute loop antenna and said antenna element.

50.(New) The antenna apparatus as claimed in claim 48,

wherein said third switch device includes a high-frequency semiconductor device having a parasitic capacitance when said third switch device is turned off, and

wherein the antenna apparatus further includes a second inductor for

substantially canceling the parasitic capacitance.

51.(New) An antenna device apparatus comprising:

- a plurality of antenna devices; and

- a fourth switch device for selectively switching said plurality of antenna devices based on radio signals received by the plurality of antenna devices, and for connecting a selected antenna device to the feeding point,

- wherein said antenna device comprises:

- a dielectric substrate including a grounding conductor;

- a minute loop antenna provided to be electromagnetically close to said dielectric substrate, said minute loop antenna having a predetermined number N of turns and having a predetermined minute length, said minute loop antenna operating as a magnetic ideal dipole so that a magnetic current flows so as to cross said minute loop antenna when a predetermined metal plate is located closely to the antenna device; and

- at least one antenna element connected to said minute loop antenna, said at least one antenna element operating as a current antenna so that said at least one antenna element is top-loaded by said minute loop antenna and currents flow in both of said minute loop antenna and said at least one antenna element when said metal plate is located apart from the antenna device;

- wherein said antenna device further comprises at least one first capacitor

connected to at least one of said minute loop antenna and said antenna element, said at least one capacitor series-resonates with inductances of said minute loop antenna and said antenna element,

wherein one end of said antenna device is connected to a feeding point, and another end of said antenna device is connected to the grounding conductor of said dielectric substrate, and

wherein said antenna device operates as a magnetic ideal dipole by said minute loop antenna when said metal plate is located closely to the antenna device, while said antenna device operates as a current antenna by said at least one antenna element when said metal plate is located apart from the antenna device.

52.(New) The antenna device apparatus as claimed in claim 51,

wherein said fourth switch device grounds said unselected antenna devices.

53.(New) The antenna apparatus as claimed in claim 31,

wherein said antenna apparatus is formed on a surface of said dielectric substrate on which the grounding conductor is not formed.

54.(New) The antenna apparatus as claimed in claim 53,
wherein said minute loop antenna is formed on a further dielectric substrate.

55.(New) The antenna apparatus as claimed in claim 54,
wherein said further dielectric substrate includes at least one convex portion,

wherein said dielectric substrate includes at least one hole portion fitted into the at least one concave portion of said dielectric substrate, and

wherein said at least one convex portion of said further dielectric substrate is fitted into the at least one hole portion of said dielectric substrate, so that said further dielectric substrate is coupled with said dielectric substrate.

56.(New) The antenna apparatus as claimed in claim 54,
wherein said dielectric substrate includes at least one convex portion,
wherein said further dielectric substrate includes further at least one hole portion for being inserted and fitted into the at least one concave portion of said dielectric substrate, and

wherein said at least one convex portion of said dielectric substrate is inserted and fitted into the at least one hole portion of said further dielectric substrate, so that said dielectric substrate is coupled with said further dielectric

substrate.

57.(New) The antenna apparatus as claimed in claim 55, further comprising:
a first connection conductor formed on said dielectric substrate, said first connection conductor being connected to said antenna element; and
a second connection conductor formed on said further dielectric substrate, said second connection conductor being connected to said minute loop antenna, wherein said first connection conductor is electrically connected to said second connection conductor when said dielectric substrate is coupled with said further dielectric substrate.

58.(New) The antenna apparatus as claimed in claim 57,
wherein said first connection conductor includes a first conductor exposed section, which is a part of said first connection conductor and has a predetermined first area, said connection conductor being formed to be soldered so that said first connection conductor is electrically connected to said second connection conductor, and
wherein said second connection conductor includes a second conductor exposed section, which is a part of said second connection conductor and has a predetermined second area, said second connection conductor being formed to be soldered so that said second connection conductor is electrically connected

to said first connection conductor.

59.(New) A radio communication apparatus comprising:

- an antenna apparatus; and

- a radio communication circuit connected to said antenna apparatus,

- wherein said antenna apparatus comprises:

- a dielectric substrate including a grounding conductor;

- a minute loop antenna provided to be electromagnetically close to said dielectric substrate, said minute loop antenna having a predetermined number N of turns and having a predetermined minute length, said minute loop antenna operating as a magnetic ideal dipole so that a magnetic current flows so as to cross said minute loop antenna when a predetermined metal plate is located closely to the antenna apparatus; and

- at least one antenna element connected to said minute loop antenna, said at least one antenna element operating as a current antenna so that said at least one antenna element is top-loaded by said minute loop antenna and currents flow in both of said minute loop antenna and said at least one antenna element when said metal plate is located apart from the antenna apparatus;

- wherein said antenna apparatus further comprises at least one first capacitor connected to at least one of said minute loop antenna and said antenna element, said at least one capacitor series-resonates with inductances

of said minute loop antenna and said antenna element,

wherein one end of said antenna apparatus is connected to a feeding point, and another end of said antenna apparatus is connected to the grounding conductor of said dielectric substrate, and

wherein said antenna apparatus operates as a magnetic ideal dipole by said minute loop antenna when said metal plate is located closely to the antenna apparatus, while said antenna apparatus operates as a current antenna by said at least one antenna element when said metal plate is located apart from the antenna apparatus.